CLAIMS:

1. A system and method for directing post-processing to improve picture quality of a decoded digital video signal encoded as a sequence of at least one frame of block-based data, said system comprising:

a metric calculation unit for calculating a unified metric for digital video processing (UMDVP) for each pixel in the frame in accordance with a frame type to produce a UMDVP metric map, wherein the calculation unit comprises:

a module that defines local spatial features in the frame,

means for estimating block-based motion as one of a motion vector for the block of pixels and as at least one motion vector for the frame,

a module that detects a scene change in the frame,

means for scaling for the UMDVP metric map to align with the resolution of the decoded video when the UMDVP metric map does not align with the resolution of the decoded video, and

means for interpolating the value of UMDVP when the position pointed at by the motion vector does not co-site with a pixel; and

a post-processing unit having at least one quality improvement algorithm,

wherein, said calculation unit produces a scaled and interpolated UMDVP metric map for the frame, said post-processing unit directs said at least one quality improvement algorithm to improve quality of a decoded version of the digital video signal based on the UMDVP metric map, said at least one quality improvement algorithm improves the quality of the decoded version of the digital video based on the UMDVP metric map, and said at least one quality improvement algorithm is selected from the group consisting of enhancement algorithms and artifact reduction algorithms.

2. The system of claim 1, wherein the calculation unit further comprises a module that analyzes macroblock and block-based coding information according to the formula:

$$UMDVP(i,j) = \frac{\dfrac{num\_bits}{q\_scale} - Q\_OFFSET}{Q\_OFFSET} \quad \text{for } num\_bits \neq 0$$

$UMDVP(i,j) = 0$ for $num\_bits = 0$

wherein, $UMDVP(i,j) \in [1,-1]$ is a metric for a pixel(i,j) of a block of pixel data, q_scale is a quantization scale for the macroblock, num_bits is a number of bits to encode a luminance block, and Q_OFFSET is an experimentally pre-determined value.

3. The system of claim 2, wherein:

if the calculation unit determines that the frame is an I frame type and the module that detects a scene change determines that a scene change has not occurred then refinements are to the calculated value of UMDVP as follows:

the calculation unit employs the means for estimating block-based motion to obtain a motion vector (v',h') for the current block,

if the position pointed at by the motion vector (v',h') does not co-site with a pixel, the calculation unit employs the means for interpolation to perform an interpolation to obtain the value of the UMDVP metric at the position pointed at by the motion vector, and the value of the UMDVP metric is adjusted using the equation

$$UMDVP = R_1 \times UMDVP + (1 - R_1) \times UMDVP\_prev(v',h')$$

wherein, UMDVP_prev(v',h') is the value of the UMDVP metric at the location pointed at by (v',h') in the previous frame and R_1 is a pre-determined weighting factor.

4. The system of claim 3, wherein the value of UMDVP is further adjusted and refined for a local spatial feature as follows:

$UMDVP(i,j) = UMDVP(i,j) + 1$ for $UMDVP(i,j)<0, (var(i,j)>VAR\_THRED)$

and

$$UMDVP(i,j) = UMDVP(i,j) * \left(\frac{\mathrm{var}(i,j)}{VAR\_THRED} \right)^3$$

wherein, var(i,j) is a variance defined for the local spatial feature and VAR_THRED is a pre-determined threshold that is empirically determined.

5. The system of claim 4, wherein the local spatial feature is an edge and the edge-dependent local variance is defined as:

when pixel (i,j) belongs to a horizontal edge, the edge-dependent local variance is defined as:

$$var(i,j) = |pixel(i,j-1) - mean| + |pixel(i,j) - mean| + |pixel(i,j+1) - mean|$$

where $mean = \dfrac{\left(\sum_{q=-1}^{1} pixel(i,j+q)\right)}{3}$

when pixel (i,j) belongs to a vertical edge, the edge-dependent local variance is defined as:

$$var(i,j) = |pixel(i-1,j) - mean| + |pixel(i,j) - mean| + |pixel(i+1,j) - mean|$$

where $mean = \dfrac{\left(\sum_{q=-1}^{1} pixel(i+q,j)\right)}{3}$

when pixel(i,j) belongs to a diagonal edge, the edge-dependent local variance is defined as:

$$\begin{aligned} var(i,j) = {} & |pixel(i-1,j-1) - mean| + |pixel(i,j) - mean| + |pixel(i-1,j+1) - mean| \\ & + |pixel(i+1,j-1) - mean| + |pixel(i+1,j+1) - mean| \end{aligned}$$

where mean =

$$\frac{\left(pixel(i-1,j-1) + pixel(i-1,j+1) + pixel(i,j) + pixel(i+1,j-1) + pixel(i+1,j+1)\right)}{5}$$

when pixel(i,j) does not belong to any of the aforementioned edges, the variance is defined as:

$$var(i,j) = \sum_{p=-1}^{1}\sum_{q=-1}^{1} |pixel(i+p,j+q) - mean|$$

where $mean = \dfrac{\left(\sum_{p=-1}^{1}\sum_{q=-1}^{1} pixel(i+p,j+q)\right)}{9}$

6. The system of claim 3, wherein the value of UMDVP is further adjusted and refined (58) for a local spatial feature as follows:

UMDVP(i,j) = UMDVP(i,j) +1 for UMDVP(i,j)<0,(var(i,j)>VAR_THRED)

and

$$UMDVP(i,j) = UMDVP(i,j) * \left(\frac{\mathrm{var}(i,j)}{VAR\_THRED}\right)^3$$

wherein, var(i,j) is a variance defined for the local spatial feature and VAR_THRED is a pre-determined threshold that is empirically determined.

7. The system of claim 6, wherein the local spatial feature is and edge and the edge-dependent local variance is defined as:

when pixel (i,j) belongs to a horizontal edge, the edge-dependent local variance is defined as:

$$var(i,j) = |pixel(i,j-1) - mean| + |pixel(i,j) - mean| + |pixel(i,j+1) - mean|$$

$$\text{where } mean = \frac{\left(\sum_{q=-1}^{1} pixel(i,j+q)\right)}{3}$$

when pixel (i,j) belongs to a vertical edge, the edge-dependent local variance is defined as:

$$var(i,j) = |pixel(i-1,j) - mean| + |pixel(i,j) - mean| + |pixel(i+1,j) - mean|$$

$$\text{where } mean = \frac{\left(\sum_{q=-1}^{1} pixel(i+q,j)\right)}{3}$$

when pixel(i,j) belongs to a diagonal edge, the edge-dependent local variance is defined as:

$$\begin{aligned} var(i,j) = {} & |pixel(i-1,j-1) - mean| + |pixel(i,j) - mean| + |pixel(i-1,j+1) - mean| \\ & + |pixel(i+1,j-1) - mean| + |pixel(i+1,j+1) - mean| \end{aligned}$$

where mean =

$$\frac{(pixel(i-1,j-1) + pixel(i-1,j+1) + pixel(i,j) + pixel(i+1,j-1) + pixel(i+1,j+1))}{5}.$$

when pixel(i,j) does not belong to any of the aforementioned edges, the variance is defined as:

$$var(i,j)=\sum_{p=-1}^{1}\sum_{q=-1}^{1}\left|pixel(i+p,j+q)-mean\right|$$

where $mean=\dfrac{\left(\sum_{p=-1}^{1}\sum_{q=-1}^{1}pixel(i+p,j+q)\right)}{9}$.

8. The system of claim 2, wherein:

if the calculation unit determines that the frame is one of a P or B frame type then:

if the module that detects a scene change determines that a scene change has not occurred or the condition $((Intra-block)\, and\ (num\_bits \neq 0))$ is not satisfied then refinements are made to the calculated value of UMDVP as follows-

a. the calculation module employs the means for motion estimation to calculate a motion vector (v',h') for the current block,

b. if the position pointed at by (v',h') does not co-site with a pixel, the calculation unit employs the means for interpolation to perform an interpolation to obtain the value of the UMDVP metric at the position point at by the motion vector, and

c. the value of the UMDVP metric is set as follows

UMDVP = UMDVP_prev(v'h')

wherein UMDVP_prev(v',h') is the value of the UMDVP metric at the location pointed at by (v',h') in the previous frame.

9. The system of claim 8, wherein the value of UMDVP is further adjusted and refined for a local spatial feature as follows:

UMDVP(i,j) = UMDVP(i,j) +1 for UMDVP(i,j)<0,(var(i,j)>VAR_THRED)

and

$$UMDVP(i,j)=UMDVP(i,j)*\left(\frac{\mathrm{var}(i,j)}{VAR\_THRED}\right)^3$$

wherein, var(i,j) is a variance defined for the local spatial feature and VAR_THRED is a pre-determined threshold that is empirically determined.

10. The system of claim 9, wherein the local spatial feature is an edge and the edge-dependent local variance is defined as:

when pixel (i,j) belongs to a horizontal edge, the edge-dependent local variance is defined as:

$$var(i,j) = |pixel(i,j-1) - mean| + |pixel(i,j) - mean| + |pixel(i,j+1) - mean|$$

$$\text{where } mean = \frac{\left(\sum_{q=-1}^{1} pixel(i,j+q)\right)}{3}$$

when pixel (i,j) belongs to a vertical edge, the edge-dependent local variance is defined as:

$$var(i,j) = |pixel(i-1,j) - mean| + |pixel(i,j) - mean| + |pixel(i+1,j) - mean|$$

$$\text{where } mean = \frac{\left(\sum_{q=-1}^{1} pixel(i+q,j)\right)}{3}$$

when pixel(i,j) belongs to a diagonal edge, the edge-dependent local variance is defined as:

$$var(i,j) = |pixel(i-1,j-1) - mean| + |pixel(i,j) - mean| + |pixel(i-1,j+1) - mean| \\ + |pixel(i+1,j-1) - mean| + |pixel(i+1,j+1) - mean|$$

where mean =

$$\frac{(pixel(i-1,j-1) + pixel(i-1,j+1) + pixel(i,j) + pixel(i+1,j-1) + pixel(i+1,j+1))}{5}$$

when pixel(i,j) does not belong to any of the aforementioned edges, the variance is defined as:

$$var(i,j) = \sum_{p=-1}^{1}\sum_{q=-1}^{1} |pixel(i+p,j+q) - mean|$$

$$\text{where } mean = \frac{\left(\sum_{p=-1}^{1}\sum_{q=-1}^{1} pixel(i+p,j+q)\right)}{9}$$

11. The system of claim 1, wherein the enhancement algorithm is a sharpness enhancement algorithm comprising one of peaking and transient improvement.

12. The system of claim 11, wherein:

the sharpness enhancement algorithm is a peaking algorithm; and

the UMDVP metric is adjusted as follows before applying it to the output of the peaking algorithm

$$UMDVP = \begin{cases} UMDVP & \\ UMDVP + 0.5 & \text{when} \\ 1.0 & \end{cases} \quad \begin{matrix} UMDVP \leq 0.3 \\ 0.3 < UMDVP < 0.5 \\ UMDVP \geq 0.5 \end{matrix} \; .$$

13. The system of claim 12, wherein the output of the peaking algorithm is controlled by the technique of coring and the UMDVP metric is applied to the output of the coring technique.

14. A method for directing post-processing to improve picture quality of a decoded digital video signal, said system comprising:

providing a module that defines local spatial features in the frame;

providing means for estimating block-based motion vectors for the frame;

providing a module that detects a scene change in the frame;

providing means for interpolating the UMDVP metric if the location pointed at by the

motion vector does not co-site with a pixel;

calculating a unified metric UMDVP for digital video processing (UMDVP) for each pixel in the frame based on frame type, local spatial feature, block-based motion estimation, and detected scene changes;

producing a UMDVP metric map of the calculated UMDVP metric for each pixel;

if the UMDVP metric map does not align with the resolution of the decoded signal, scaling the metric map to align the UMDVP metric map with the resolution of the decoded signal; and

post-processing the frame by applying the UMDVP metric map to direct the selection and aggressiveness of at least one quality improvement algorithm selected from the group consisting of enhancement algorithms and artifact reduction algorithms.

15. The method of claim 14, wherein the calculating step further comprises the step of analyzing macroblock and block-based coding information and calculating the UMDVP metric according to the formula:

$$UMDVP(i,j) = \frac{\frac{num\_bits}{q\_scale} - Q\_OFFSET}{Q\_OFFSET} \quad \text{for } num\_bits \neq 0$$

$$UMDVP(i,j) = 0 \quad \text{for } num\_bits = 0$$

wherein, $UMDVP(i,j) \in [1,-1]$ is a metric for a pixel(i,j) of a block of pixel data, q_scale is a quantization scale for the macroblock, num_bits is a number of bits to encode a luminance block, and Q_OFFSET is an experimentally pre-determined value.

16. The method of claim 15, further comprising the steps of:

determining that the frame is an I frame type;

if a scene change has not been detected and the frame has been determined to be an I frame type, estimating a motion vector (v',h') for the current block by the means for estimating;

if the position pointed at by the motion vector (v',h') does not co-site with a pixel, performing an interpolation to obtain the value of the UMDVP metric at the position pointed at by the motion vector (v',h') by the means for interpolating; and

adjusting the value of the UMDVP metric using the equation

$$UMDVP = R_1 \times UMDVP + (1 - R_1) \times UMDVP\_prev(v',h')$$

wherein, UMDVP_prev(v',h') is the value of the UMDVP metric at the location pointed at by (v',h') in the previous frame and R_1 is a pre-determined weighting factor.

17. The method of claim 16, further comprising the steps of:

adjusting the value of UMDVP for a local spatial feature as follows:

UMDVP(i,j) = UMDVP(i,j) +1 for UMDVP(i,j)<0,(var(i,j)>VAR_THRED)

and

$$UMDVP(i,j) = UMDVP(i,j) * \left(\frac{var(i,j)}{VAR\_THRED} \right)^3$$

wherein, var(i,j) is a variance defined for the local spatial feature and VAR_THRED is a pre-determined threshold that is empirically determined.

18. The method of claim 17, further comprising the steps of:

if the local spatial feature is an edge, calculating the edge-dependent local variance is defined as:

when pixel (i,j) belongs to a horizontal edge, the edge-dependent local variance is defined as:

$$var(i,j) = |pixel(i,j-1) - mean| + |pixel(i,j) - mean| + |pixel(i,j+1) - mean|$$

where $mean = \frac{\left(\sum_{q=-1}^{1} pixel(i,j+q) \right)}{3}$

when pixel (i,j) belongs to a vertical edge, the edge-dependent local variance is defined as:

$$var(i,j) = |pixel(i-1,j) - mean| + |pixel(i,j) - mean| + |pixel(i+1,j) - mean|$$

where $mean = \frac{\left(\sum_{q=-1}^{1} pixel(i+q,j) \right)}{3}$

when pixel(i,j) belongs to a diagonal edge, the edge-dependent local variance is defined as:

$$\begin{aligned} var(i,j) = {} & |pixel(i-1,j-1) - mean| + |pixel(i,j) - mean| + |pixel(i-1,j+1) - mean| \\ & + |pixel(i+1,j-1) - mean| + |pixel(i+1,j+1) - mean| \end{aligned}$$

where mean =

$$\frac{\left(pixel(i-1,j-1)+pixel(i-1,j+1)+pixel(i,j)+pixel(i+1,j-1)+pixel(i+1,j+1)\right)}{5}$$

when pixel(i,j) does not belong to any of the aforementioned edges, the variance is defined as:

$$var(i,j)=\sum_{p=-1}^{1}\sum_{q=-1}^{1}\left|pixel(i+p,j+q)-mean\right|$$

where $mean=\frac{\left(\sum_{p=-1}^{1}\sum_{q=-1}^{1}pixel(i+p,j+q)\right)}{9}$.

19. The method of claim 15, further comprising the steps of:

determining that the frame is one of a P or B frame type;

if a scene change has not been detected or the condition

$$((Intra-block)\, and\ (num\_bits \neq 0))$$

is not satisfied, estimating a motion vector (v',h') for the current block by the means for estimating;

if the position pointed at by the motion vector (v',h') does not co-site with a pixel, obtaining the value of the UMDVP metric at the position pointed by the motion vector (v',h') by the means for interpolating; and

adjusting the value of the UMDVP metric using the equation

UMDVP = UMDVP_prev(v'h'),

wherein, UMDVP_prev(v',h') is the value of the UMDVP metric at the location pointed at by (v',h') in the previous frame.

20. The method of claim 19, further comprising the steps of:

adjusting the value of UMDVP for a local spatial feature as follows:

UMDVP(i,j) = UMDVP(i,j) +1 for UMDVP(i,j)<0,(var(i,j)>VAR_THRED)

and

$$UMDVP(i,j)=UMDVP(i,j)*\left(\frac{var(i,j)}{VAR\_THRED}\right)^{3}$$

wherein, var(i,j) is a variance defined for the local spatial feature and VAR_THRED is a pre-determined threshold that is empirically determined.

21. The method of claim 20, further comprising the steps of:

if the local spatial feature is an edge, calculating the edge-dependent local variance as:

when pixel (i,j) belongs to a horizontal edge, the edge-dependent local variance is defined as:

$$var(i,j) = |pixel(i,j-1) - mean| + |pixel(i,j) - mean| + |pixel(i,j+1) - mean|$$

where $mean = \dfrac{\left(\sum_{q=-1}^{1} pixel(i,j+q)\right)}{3}$

when pixel (i,j) belongs to a vertical edge, the edge-dependent local variance is defined as:

$$var(i,j) = |pixel(i-1,j) - mean| + |pixel(i,j) - mean| + |pixel(i+1,j) - mean|$$

where $mean = \dfrac{\left(\sum_{q=-1}^{1} pixel(i+q,j)\right)}{3}$

when pixel(i,j) belongs to a diagonal edge, the edge-dependent local variance is defined as:

$$\begin{aligned} var(i,j) = {} & |pixel(i-1,j-1) - mean| + |pixel(i,j) - mean| + |pixel(i-1,j+1) - mean| \\ & + |pixel(i+1,j-1) - mean| + |pixel(i+1,j+1) - mean| \end{aligned}$$

where mean =

$$\frac{(pixel(i-1,j-1) + pixel(i-1,j+1) + pixel(i,j) + pixel(i+1,j-1) + pixel(i+1,j+1))}{5}$$

when pixel(i,j) does not belong to any of the aforementioned edges, the variance is defined as:

$$var(i,j) = \sum_{p=-1}^{1}\sum_{q=-1}^{1} |pixel(i+p,j+q) - mean|$$

where $mean = \dfrac{\left(\sum_{p=-1}^{1}\sum_{q=-1}^{1} pixel(i+p,j+q)\right)}{9}$

22. The method of claim 14, wherein the enhancement algorithm is a sharpness enhancement algorithm comprising one of peaking and transient improvement.

23. The method of claim 22, wherein:

the sharpness enhancement algorithm is a peaking algorithm; and

further comprising the step of adjusting the UMDVP metric as follows before applying it to the output of the peaking algorithm

$$UMDVP = \begin{cases} UMDVP & \text{when} \quad UMDVP \le 0.3 \\ UMDVP + 0.5 & \quad 0.3 < UMDVP < 0.5 \\ 1.0 & \quad UMDVP \ge 0.5 \end{cases}$$

24. The method of claim 23, further comprising the steps of :

controlling the output of the peaking algorithm by the technique of coring; and

applying the UMDVP metric the output of the coring technique.